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United States Patent and Trademark Office

June 23, 2005

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A FILING DATE.

APPLICATION NUMBER: 60/603,296

FILING DATE: August 20, 2004

RELATED PCT APPLICATION NUMBER: PCT/US05/08297



Certified by

Don W. Duchs

Under Secretary of Commerce
for Intellectual Property
and Director of the United States
Patent and Trademark Office

22651 U.S. PTO
082004

PTO/SB/16 (01-04)

Approved for use through 07/31/2006. OMB 0651-0032

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Express Mail Label No. ER 009856767 US

22651 U.S. PTO
60/603296

082004

INVENTOR(S)					
Given Name (first and middle (if any))		Family Name or Surname		Residence (City and either State or Foreign Country)	
David Brian		Jackson		Spanish Fork, Utah County, Utah	
Additional inventors are being named on the _____ separately numbered sheets attached hereto					
TITLE OF THE INVENTION (500 characters max)					
System and Method of Managing and Monitoring Cluster and Grid Resources					
Direct all correspondence to: CORRESPONDENCE ADDRESS					
<input checked="" type="checkbox"/> Customer Number: 40271					
OR					
<input type="checkbox"/> Firm or Individual Name					
Address					
Address					
City		State		Zip	
Country		Telephone		Fax	
ENCLOSED APPLICATION PARTS (check all that apply)					
<input checked="" type="checkbox"/> Specification Number of Pages 3		<input checked="" type="checkbox"/> CD(s), Number 2			
<input type="checkbox"/> Drawing(s) Number of Sheets		<input checked="" type="checkbox"/> Other (specify) CD listing, post card			
<input checked="" type="checkbox"/> Application Data Sheet. See 37 CFR 1.76					
METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT					
<input checked="" type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27.				FILING FEE Amount (\$)	
<input type="checkbox"/> A check or money order is enclosed to cover the filing fees.				80.00	
<input type="checkbox"/> The Director is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number: _____					
<input checked="" type="checkbox"/> Payment by credit card. Form PTO-2038 is attached.					
The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.					
<input checked="" type="checkbox"/> No.					
<input type="checkbox"/> Yes, the name of the U.S. Government agency and the Government contract number are: _____					

[Page 1 of 2]

Respectfully submitted,

SIGNATURE

Thomas M. Isaacson

TYPED or PRINTED NAME Thomas M. Isaacson

TELEPHONE 410-414-3056

Date August 20, 2004

REGISTRATION NO. 44166

(if appropriate)

Docket Number: 010-0010P4

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

This collection of information is required by 37 CFR 1.51. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Mail Stop Provisional Application, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: :
 :
 David Brian Jackson : Attorney Ref.: 010-0010P4
 :
 Serial No.: : Confirmation No.:
 :
 Filed: August 20, 2004 : Art Unit:
 :
 FOR: SYSTEMS AND METHOD OF : Examiner:
 MANAGING AND MONITORING :
 CLUSTER AND GRID RESOURCES :

37 C.F.R. 1.54(e) CD LISTING OF DOCUMENTS

Commissioner for Patents
 P.O. Box 1450
 Alexandria, VA 22313-1450

Dear Sir:

As required by 37 C.F.R. 1.54(e), the attached CDs include the following documents.

Each compact disc is created in the IBM-PC format using the MS-Windows XP operating system. The following table provides a list of files with their names, dates of creation, size in bytes and creating program.

The CD contains a set of text files that combined comprise the source code for the software program known as MOAB™. The source code is contained in simple wordpad text files.

CD LISTING OF DOCUMENTS

Item #	Title	Size in Bytes	Date of Creation	Doc. Type
1	MGridStub.c	2KB	07/28/2004	Wordpad C file
2	MAcct.c	9 KB	08/3/2004	Wordpad C file
3	MACL.c	20 KB	08/12/2004	Wordpad C file
4	MAM.c	94 KB	8/19/2004	Wordpad C file
5	MAppSim.c	9 KB	07/28/2004	Wordpad C file
6	MAuth.c	0 MB	07/28/2004	Wordpad C file
7	MBF.c	40 KB	07/28/2004	Wordpad C file
8	MClass.c	21 KB	07/28/2004	Wordpad C file
9	MClient.c	65 KB	08/17/2004	Wordpad C file

10	MCluster.c	51 KB	08/12/2004	Wordpad C file
11	MConfig.c	53 KB	08/17/2004	Wordpad C file
12	MConst.c	80 KB	08/19/2004	Wordpad C file
13	MCP.c	32 KB	08/16/2004	Wordpad C file
14	Mcred.c	118 KB	08/19/2004	Wordpad C file
15	MDAG.c	8 KB	08/06/2004	Wordpad C file
16	MFile.c	29 KB	07/28/2004	Wordpad C file
17	MFS.c	33 KB	08/03/2004	Wordpad C file
18	MGroup.c	11 KB	08/03/2004	Wordpad C file
19	MUtil.c	28 KB	08/16/2004	Wordpad C file
20	MJob.c	424 KB	08/17/2004	Wordpad C file
21	MLimit.c	7 KB	07/28/2004	Wordpad C file
22	MLocal.c	7 KB	07/28/2004	Wordpad C file
23	MLog.c	10 KB	08/05/2004	Wordpad C file
24	MMB.c	12 KB	08/11/2004	Wordpad C file
25	MNatI.c	41 KB	08/19/2004	Wordpad C file
26	MNode.c	210 KB	08/19/2004	Wordpad C file
27	MPar.c	61 KB	08/16/2004	Wordpad C file
28	MPolicy.c	53 KB	07/28/2004	Wordpad C file
29	MPreempt.c	8 KB	07/28/2004	Wordpad C file
30	MPriority.c	36 KB	07/28/2004	Wordpad C file
31	MQOS.c	44 KB	08/06/2004	Wordpad C file
32	MQueue.c	52 KB	08/18/2004	Wordpad C file
33	MRM.c	149 KB	08/18/2004	Wordpad C file
34	MRsv.c	252 KB	08/19/2004	Wordpad C file
35	MSched.c	191 KB	08/16/2004	Wordpad C file
36	MSim.c	63 KB	08/09/2004	Wordpad C file
37	MSR.c	76 KB	08/19/2004	Wordpad C file
38	MStats.c	100 KB	08/13/2004	Wordpad C file
39	MSys.c	146 KB	08/19/2004	Wordpad C file
40	MTime.c	9 KB	07/28/2004	Wordpad C file
41	MTrace.c	61 KB	07/29/2004	Wordpad C file
42	MTrig.c	56 KB	08/17/2004	Wordpad C file
43	MUH.c	21 KB	07/28/2004	Wordpad C file
44	MUI.c	368 KB	08/19/2004	Wordpad C file
45	MUser.c	19 KB	08/11/2004	Wordpad C file
46	MUtil.c	124 KB	08/17/2004	Wordpad C file
47	MWikil.c	58 KB	08/13/2004	Wordpad C file
48	MXConfig.c	3 KB	07/28/2004	Wordpad C file
49	MXI.c	6 KB	07/28/2004	Wordpad C file
50	samplec.c	1 KB	07/28/2004	Wordpad C file

Respectfully submitted,

Date: August 20, 2004

by: Correspondence Address:
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SYSTEM AND METHOD OF MANAGING AND MONITORING CLUSTER AND GRID RESOURCES

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a resource management system and more specifically to a system and method of managing and monitoring cluster resources.

2. Introduction

[0002] Managers of clusters desire maximum return on investment often meaning high system utilization and the ability to deliver various qualities of service to various users and groups. A cluster is typically defined as a parallel computer that is constructed of commodity components and runs as its system software commodity software. A cluster contains nodes each containing one or more processors, memory that is shared by all of the processors in the respective node and additional peripheral devices such as storage disks that are connected by a network that allows data to move between nodes.

[0003] The managers of such clusters need to understand how the available resources are being delivered to the various users over time and need the ability to have the administrators tune 'cycle delivery' to satisfy the current site mission objectives.

[0004] How well a scheduler succeeds can only be determined if various metrics are established and a means to measure these metrics are available. While statistics are important, their value is limited unless optimal statistical values are also known for the current environment including workload, resources, and policies. If one could determine that a site's typical workload obtained an average queue time of 3 hours on a particular system, this would be a good statistic. However, if one knew that through proper tuning, the system could deliver an average queue time of 1.2 hours with minimal negative side effects, this would be valuable knowledge.

[0005] The present invention was developed to address these issues. At its core, the invention provides a number of software tools designed to truly manage cluster resources and provide meaningful information about what is actually happening on the system. The inventions were created to satisfy real-world needs of a batch system administrator as he or she tries to balance the needs of users, staff, and managers.

DETAILED DESCRIPTION OF THE INVENTION

[0006] The details of the present invention will be understood with reference to the associated documents attached as Appendix A hereto and further includes a CD according to 37 C.F.R. 1.54(e) and 1.96. There are two copies of the CD (Copy 1 and Copy 2). Each copy contains the same identical set of documents. The enclosed CD Listing of Documents will set forth the documents on the CD. The set of documents is all the source code to the MOAB™ workload manager. Each document contained on the CDs is incorporated herein by reference into this patent application.

[0007] Embodiments within the scope of the present invention may also include computer-readable media for carrying or having computer-executable instructions or data structures stored thereon. Such computer-readable media can be any available media that can be accessed by a general purpose or special purpose computer. By way of example, and not limitation, such computer-readable media can comprise RAM, ROM, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to carry or store desired program code means in the form of computer-executable instructions or data structures. When information is transferred or provided over a network or another communications connection (either hardwired, wireless, or combination thereof) to a computer, the computer properly views the connection as a computer-readable medium. Thus, any

such connection is properly termed a computer-readable medium. Combinations of the above should also be included within the scope of the computer-readable media.

[0008] Computer-executable instructions include, for example, instructions and data which cause a general purpose computer, special purpose computer, or special purpose processing device to perform a certain function or group of functions. Computer-executable instructions also include program modules that are executed by computers in stand-alone or network environments. Generally, program modules include routines, programs, objects, components, and data structures, etc. that perform particular tasks or implement particular abstract data types. Computer-executable instructions, associated data structures, and program modules represent examples of the program code means for executing steps of the methods disclosed herein. The particular sequence of such executable instructions or associated data structures represents examples of corresponding acts for implementing the functions described in such steps.

[0009] Those of skill in the art will appreciate that other embodiments of the invention may be practiced in network computing environments with many types of computer system configurations, including personal computers, hand-held devices, multi-processor systems, microprocessor-based or programmable consumer electronics, network PCs, minicomputers, mainframe computers, and the like. Embodiments may also be practiced in distributed computing environments where tasks are performed by local and remote processing devices that are linked (either by hardwired links, wireless links, or by a combination thereof) through a communications network. In a distributed computing environment, program modules may be located in both local and remote memory storage devices.

The Law Office of Thomas M. Isaacson
Intellectual Property Law

APPLICATION DATA SHEET

Applicant Information

Application Type: Provisional
Subject Matter: Utility
CD-ROM or CD-R: Yes
Title: **SYSTEM AND METHOD OF MANAGING
AND MONITORING CLUSTER AND GRID
RESOURCES**
Attorney Docket Number: 010-0010P4
Total Drawing Sheets:
Small Entity: Yes

Applicant Information

Applicant Authority Type: Inventor
Status: Full Capacity
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County: Utah County
State: Utah
Country of Residence: USA

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Related Patent Application Information

Docket No.:	Type:	Parent Application	Filing Date

MARKS & CLERK

Patent and Trade Mark Attorneys

**European Patent Attorneys European Trade Mark Attorneys
Chartered Patent Attorneys Registered Trade Mark Attorneys**

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Attn: zzepo, fax

From: Epo, Accounts

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SPECIAL COMMENTS OR MESSAGE

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A LIST OF THE NAMES OF THE PARTNERS IS OPEN TO INSPECTION AT THE ABOVE ADDRESS



To the European Patent Office

Entry into the European phase (EPO as designated or elected Office)

European application number	EP05730024.6
PCT application number	PCT/US2005/008297
PCT publication number	WO2005089245
Applicant's or representative's reference	MBM.P54135EP:ls
1. Applicant Particulars of the applicant(s) are contained in the international publication or were recorded by the International Bureau subsequent to the international publication. Changes which have not yet been recorded by the International Bureau are set out here: Address for correspondence	<input checked="" type="checkbox"/> <input type="checkbox"/>
2. Representative 1 This is the representative who will be listed in the Register of European Patents and to whom notifications will be made Name Registration No Address of place of business Telephone Fax e-mail Any additional representative(s) is/are listed here:	HARDING Richard 041295.7 4220 Nash Court Oxford Business Park South Oxford, Oxfordshire, OX4 2RU United Kingdom +44(0)1865 397900 +44(0)1865 397919 rharding@marks-clerk.com <input type="checkbox"/>
3. General Authorisation: An individual authorisation is attached. A general authorisation has been registered under No: A general authorisation has been filed, but not yet registered. The authorisation filed with the EPO as PCT receiving Office expressly includes the European phase.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
4. Request for examination Examination of the application under Art. 94 EPC is hereby requested. The examination fee is being (has been, will be) paid. Request for examination in an admissible non-EPO language:	<input checked="" type="checkbox"/> <input type="checkbox"/>
5. Copies One or more additional sets of copies of the documents cited in the supplementary European search report are hereby requested. Number of additional sets of copies	<input type="checkbox"/>
6. Documents intended for proceedings before the EPO 6.1 Proceedings before the EPO as designated Office (PCT I) are to be based on the following documents: the application documents published by the International Bureau (with all claims, description and drawings), where applicable with amended claims under Art. 19 PCT	<input type="checkbox"/>

7

6.2 Proceedings before the EPO as elected Office (PCT II) are to be based on the following documents:

the documents on which the international preliminary examination report is based, including any annexes

☐

unless replaced by the amendments attached.

☒

Where necessary, clarifications should be attached as 'Other Documents'

If the EPO as International Preliminary Examining Authority has been supplied with test reports, these may be used as the basis of proceedings before the EPO.

□

Translations in one of the official languages of the EPO (English, French, German) are attached as crossed below:

7

* In proceedings before the EPO as designated or elected Office (PCT I + II):

Translation of the international application (description, claims, any text in the drawings) as originally filed, of the abstract as published and of any indication under Rule 13bis.3 and 13bis.4 PCT regarding biological material

□

Translation of the priority application(s)

7

It is hereby declared that the international application as originally filed is a complete translation of the previous application (Rule 38(5) EPC)

☐

* In addition, in proceedings before the EPO as designated Office (PCT I):

Translation of amended claims and any statement under Art. 19 PCT, if the claims as amended are to form the basis for the proceedings before the EPO (see Section 6).

□

⁴ In addition, in proceedings before the EPO as elected office (PCT II):

Translation of annexes to the international preliminary examination report

7

The invention relates to and/or uses biological material deposited under Rule 28 EPC.

7

The particulars referred to in Rule 28(1)(c) EPC (if not yet known, the depository institution and the identification reference(s)) [number, symbols, etc.] of the depositor) are given in the international publication or in the translation submitted under Section 7 on:

7

page(s) / line(s)

A copy of the receipt(s) of deposit issued by the depository institution is attached

4

will be filed at a later date

A waiver of the right to an undertaking from the requester pursuant to Rule 28(3) EPC is attached.

The items required under Rules 5.2 and 13ter PCT and Rule 111(3) EPC have already been furnished to the EPO.

7

The sequence listing as part of the description is attached in PDF format.

7

The sequence listing does not include matter that goes beyond the content of the application as filed.

7

In addition, the sequence listing data is attached in computer-readable form in accordance with WIPO Standard 25.

The sequence listing data in computer-readable form in accordance with WIPO Standard 25 is identical to the sequence listing in PDF format.

7

10.1 It is currently intended to pay seven times the amount of the designation fee. The designation fees for all the EPC contracting states designated in the international application are thereby deemed to have been paid (Art. 2 No. 3 RFees).

☒

AT BE BG CH&LI CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LT LU MC

NL PL PT RO SE SI SK TR

10.2 It is currently intended to pay fewer than seven designation fees for the following EPC contracting states designated in the international application:

☐

10.3 It is requested that no communication under Rules 85a(1) or 69(1) need be notified in respect of the contracting states not indicated. If an automatic debit order has been issued, the EPO is authorised, on expiry of the basic period under Article 79(2), to debit seven times the amount of the designation fee. If less than seven states are indicated, the EPO shall debit designation fees only for those states, unless it is instructed to do otherwise before expiry of the basic period.

☒**11. Extension of the European patent**

This application is also considered as being a request for extension to all the non-contracting states to the EPC designated in the international application with which "extension agreements" were in force on the date of filing the international application. However, the extension only takes effect if the prescribed extension fee is paid.

☒

It is currently intended to pay the extension fee for the following states:

12. List of enclosed documents

	Description of document	Original file name	Assigned file name
1	Amended claims	P54135EP amended claims.pdf	CLMS.pdf
2	PreConversion Archive	P54135EP amended claims.zip	OLF-ARCHIVE.zip
3	Replacement description page 5	P54135EP-PCT-replacement-sheet-5.pdf	OTHER-1.pdf
4	Replacement description page 20	P54135EP-PCT-replacement-sheet-5.pdf	OTHER-2.pdf

13. Payment

Currency

☐
EUR**14. Reimbursements (if any) should be made to the following EPO deposit account:**☐**15. Fees**

		Factor/Reduction applied	Fee schedule	Amount to be paid
15-1	002e Fee for supplementary European search for applications filed before 01.07.2005	0.8	720.00	576.00
15-2	005 Designation fee	7	80.00	560.00
15-3	006e Examination fee (Euro-PCT without supplementary European search report)	1	1 490.00	1 490.00
15-4	015 Claims fee	27	45.00	1 215.00
15-5	020 Basic national fee for an international application	1	95.00	95.00
Total:			EUR	3 936.00

16. Annotations

16-1. Note (for EPO) (EP Phase)

Mode of payment (; 12.09.2006)

The official fees will be paid from our deposit account No. 28050065, using EPO Form 1010 which will be filed by our London office. Please debit/credit our deposit account in case of under/overpayment.

17. Signature(s) of applicant(s) or representative

Place:

Oxford

Date:

13.September 2006

Signed by:

GB, Marks & Clerk, R. Harding 1314

Capacity:

(Representative)

CLAIMS

1. A method of co-allocating resources within a compute environment, the method comprising:
 - receiving a first request for a reservation for a first type of resource;
 - analyzing constraints and guarantees associated with the first request;
 - identifying a first group of resources that meet the first request;
 - receiving a second request for a reservation for a second type of resource;
 - analyzing constraints and guarantees associated with the second request;
 - identifying a second group of resources that meet the second request; and
 - generating a co-allocation map between the first group of resources and the second group of resources.
2. The method of claim 1, further comprising reserving resources according to the generated co-allocation map.
3. The method of claim 1 or 2, wherein generating the co-allocation map comprises identifying a reduced map of quantities of resources that can simultaneously satisfy the first request and the second request.
4. The method of claim 3, wherein the co-allocation map comprises all time frames where available resources exist that satisfy the first request and the second request.
5. The method of any one of the preceding claims, wherein possible types of resources comprise at least one of: compute resources, disk storage resources, network bandwidth resources, memory resources, licensing resources.
6. The method of claim 1, wherein generating the co-allocation map further comprises identifying an intersection of the availability of each of the first type of resource and the second type of resource.
7. The method of claim 6, wherein generating the co-allocation map further comprises determining intersecting time frames in which both the first request and the second request may be simultaneously satisfied.

8. The method of claim 7, further comprising:
generating a resulting array of events describing the intersecting time frames.
9. The method of claim 8, wherein the resulting array of events comprises at least one of resource quantity, resource quality, time frames, quality of information and cost.
10. The method of any one of the preceding claims, wherein the first request and the second request comprise at least one of: a job description, at least one time frame availability, a description of minimum resources, a description of resource types and attributes, a reservation duration minimum.
11. The method of any one of the preceding claims, wherein identifying the first group of resources and the second group of resources further comprises analyzing events associated with the first request and the second request and how resource availability changes over time.
12. The method of claim 11, wherein the events comprise at least one of job start, job completion, state change, boundaries, reservations and policy enforcement limits.
13. The method of any one of the preceding claims, further comprising reporting at least one of the following parameters associated with the identified first and second group of resources: cost, quality of information data, resource quantity data, time frame data, and resource quality data.
14. The method of any one of the preceding claims, further comprising:
performing again, under constraints identified by the co-allocation map, the step of identifying a first group of resources that meet the request for the first type of resource.
15. The method of claim 14, further comprising:
performing again, under constraints identified by the co-allocation map, the step of identifying a second group of resources that meet the request for the second type of resource.
16. The method of any one of the preceding claims, wherein:
receiving a request for a reservation for a first type of resource further comprises receiving a request for the first type of resource for a first time frame, and wherein the identifying and analyzing steps for the first type of resource take into account the first time frame;

receiving a request for a reservation for a second type of resource further comprises receiving a request for the second type of resource for a second time frame, wherein the identifying and analyzing steps for the second type of resource take into account the second time frame; and generating the co-allocation map between the first group of resources and the second group of resources further comprises calculating an intersection of the first time frame and the second time frame.

17. The method of any one of the preceding claims, wherein the constraints are at least one of resource matching in terms of type, attribute or quantity.
18. The method of any one of the preceding claims, wherein the constraints and guarantees associated with the first request and the second request relate to resource-based policies.
19. The method of any one of claims 1 to 17, wherein the constraints and guarantees associated with the first request and the second request relate to time-based policies.
20. The method of claim 19, wherein the time-based policies limit requestors to a pre-determined quantity of resources at any given moment in time.
21. The method of any one of the preceding claims, wherein receiving a request for a reservation for a first type of resource further comprises receiving a request for a reservation for the first type of resource having an attribute.
22. The method of claim 21, wherein the attribute is at least one of disk storage space, memory, license scope, network bandwidth capability, clock speed and central processing power.
23. The method of any one of the preceding claims, wherein the co-allocation map is computed as one of an intersection, a union or a distinct response.
24. The method of claim 23, further comprising, before reserving compute resources, presenting to a requestor of a reservation of the first and second type of resources an analysis of the compute resources and a possible reservation.
25. The method of claim 24, wherein the presented analysis relates to a quantity and quality of the compute resources in relation to the request for a reservation for resources.
26. The method of claim 25, further comprising:
receiving from the requestor of a reservation a revised request for resources based on the presented analysis.

27. The method of any one of claims 23 to 26, wherein a requestor may select that generating the co-allocation map returns an analysis according to at least one of the interaction, union or distinct response.
28. The method of claim 27, wherein the analysis returned to the requestor, according to at least one of the interaction, union or distinct response, corresponds to an analysis of the quantity of resources and a degree of fulfillment of the request according to available resources.
29. The method of claim 28, wherein the analysis returned to the requestor further comprises a list of resources that can fulfill the request of the requestor.
30. The method of claim 28, wherein the analysis returned to the requestor further comprises a transaction ID associated with the analysis.
31. The method of claim 30, further comprising presenting to the requestor an option to submit the request with reference to the transaction ID.
32. The method of any one of the preceding claims, wherein the generated co-allocation map represents a set of resources exclusive to at least one of the first request or the second request.
33. The method of claim 32, wherein the first request specifies exclusivity.
34. The method of claim 33, further comprising:
guaranteeing that the first request will be able to reserve exclusive resources.
35. The method of claim 32, further comprising generating a co-allocation map between the first group of resources and the second group of resources.
36. A method of co-allocating resources within a compute environment, the method comprising:
receiving a first request for a reservation for a first type of resource;
analyzing constraints and guarantees associated with the first request;
identifying a first group of resources that meet the request for the first type of resource;
receiving a second request for a reservation for a second type of resource;
analyzing constraints and guarantees associated with the second request;
identifying a second group of resources that meet the request for the second type of resource; and

generating a set of resources exclusive to at least one of the first request or the second request.

37. The method of claim 36, further comprising generating a co-allocation map between the first group of resources and the second group of resources.

[0016] FIG. 1B illustrates an access control list which provides access to resources within a compute environment;

[0017] FIG. 2A illustrates a plurality of reservations made for compute resources;

[0018] FIG. 2B illustrates a plurality of reservations and jobs submitted within those reservations;

[0019] FIG. 3 illustrates a dynamic access control list;

[0020] FIG. 4 illustrates a reservation creation window;

[0021] FIG. 5 the co-allocation process; and

[0022] FIG. 6 illustrates a method aspect of the invention.

[0023]

DETAILED DESCRIPTION OF THE INVENTION

[0024] Various embodiments of the invention are discussed in detail below. While specific implementations are discussed, it should be understood that this is done for illustration purposes only. A person skilled in the relevant art will recognize that other components and configurations may be used without parting from the spirit and scope of the invention.

[0025] The "system" embodiment of the invention may comprise a computing device that includes the necessary hardware and software components to enable a workload manager or a software module performing the steps of the invention. Such a computing device may include such known hardware elements as one or more central processors, random access memory (RAM), read-only memory (ROM), storage devices such as hard disks, communication means such as a modem or a card to enable networking with other computing devices, a bus that provides data transmission between various hardware components, a keyboard, a display, an operating system and so forth. There is no restriction that the particular system embodiment of the invention have any specific hardware components and any known or future developed hardware configurations are contemplated as within the scope of the invention when the computing device operates as is claimed.

[0026] The present invention relates to reservations of resources within the context of a compute environment. One example of a compute environment is a cluster. The cluster may be, for example, a group of computing devices operated by a hosting facility, a hosting center, a virtual hosting center, a data center, grid and/or utility-based computing environments. Every reservation consists of three major components: a set of resources, a timeframe, and an access control list (ACL). Additionally, a reservation may also have a number of optional attributes controlling its behavior and interaction with other aspects of scheduling. A reservation's ACL specifies which jobs

request for resources based on the returned analysis, if for example, the analysis shows that there are no resources available within a day and the user desires to start jobs earlier than that time.

[0086] Another aspect of the co-allocation of reservations relates to identifying a request with a flag related to exclusion. This is an option identified in the reservation flags options 408 in FIG. 4. The exclusive flag or parameter may be identified with one or more requests for resources. In this regard, the generated map of co-allocated resources represents a set of resources exclusive to at least one of the first request or the second request. With an exclusive parameter attached to the first request, the method may further include guaranteeing that the first request will be able to reserve exclusive resources. The method may further comprise generating a co-allocation map between the first group of resources and the second group of resources.

[0087] An example will assist in understating the co-allocation exclusion request. With reference to FIG. 5, assume a first request R1 requests a first set of resources and R2 requests a second set of resources. At least one request is set with the exclusive flag. Setting this flag changes the analysis and mapping and the end results when a reservation is committed. The exclusive analysis includes analyzing R1 during the co-allocation time frame identified and bounded in the union analysis 532 and identifying an R1 list 1 and an R1 list 2 bounded by the union time frame 532, and identifying an R2 list 1 and an R2 list 2 in the bounded time frame 532. (There may also be time frames for mappings 528 and 530 with analysis as well). An analysis is done to generate these lists called a multi-request distribute balance tasks that steps through and provides resources to the lists according to the most needy request. The result of the analysis is a transaction ID (1) for R1 which represents available resources for R1 during the union time frame 532 and a transaction ID (2) for R2 representing available resources for R2 for the time frame 532. But the underlying analysis, and what is hidden inside these transaction IDs, is a mapping in each case to an explicit set of resources. If the user then commits the co-allocation request, the reservation for this query will reserve two different explicit sets of resources guaranteed to not overlap associated with the two transaction IDs.

[0088] With this in mind, an aspect of the exclusion embodiment of the invention relates to a method of co-allocating resources within a compute environment. The method comprises receiving a first request for a reservation for a first type of resource, analyzing constraints and guarantees associated with the first request, identifying a first group of resources that meet the request for the first type of resource, receiving a second request for a reservation for a second type of resource, analyzing constraints and guarantees associated with the second request, identifying a second group of resources that meet the request for the second type of resource and generating a set of resources exclusive to at least one of the first request or the second request.



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Acknowledgement of receipt

We hereby acknowledge receipt of the form for entry into the European phase (EPO as designated or elected Office) as follows:

Submission number	156300	
PCT application number	PCT/US2005/008297	
Date of receipt	13 September 2006	
Receiving Office	European Patent Office, The Hague	
Your reference	MBM.P54135EP:ls	
Applicant		
Country		
Documents submitted	package-data.xml ep-euro-pct.xml CLMS.pdf\P54135EP amended claims.pdf (5 p.) OTHER-1.pdf\P54135EP-PCT-replacement-sheet-5.pdf (1 p.)	epf1200.pdf (3 p.) application-body.xml OLF-ARCHIVE.zip\P54135EP amended claims.zip OTHER-2.pdf\P54135EP-PCT-replacement-sheet-5.pdf (1 p.)
Submitted by	CN=R. Harding 1314,O=Marks & Clerk,C=GB	
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EPO Customer Services

Tel.: +31 (0)70 340 45 00

Date

02.08.06

Reference	Application No./Patent No. 05730024.6 - PCT/US2005008297
Applicant/Proprietor Cluster Resources, Inc.	

Entry into the European phase before the European Patent Office

These notes describe the procedural steps required for entry into the European phase before the European Patent Office (EPO). You are advised to read them carefully: failure to take the necessary action in time can lead to your application being deemed withdrawn.

1. The above-mentioned international patent application has been given European application No. **05730024.6**.
2. Applicants **without** a residence or their principal place of business in an EPC contracting state may themselves initiate European processing of their international applications, provided they do so before expiry of the 31st month from the priority date (see also point 6 below).

During the European phase before the EPO as designated or elected Office, however, such applicants must be represented by a professional representative (Arts. 133(2) and 134(1), (7) EPC).

Procedural acts performed after expiry of the 31st month by a professional representative who acted during the international phase but is not authorised to act before the EPO have no legal effect and therefore lead to loss of rights.

Please note that a professional representative authorised to act before the EPO and who acted for the applicant during the international phase does not automatically become the representative for the European phase. Applicants are therefore strongly advised to appoint in good time any representative they wish to initiate the European phase for them; otherwise, the EPO has to send all communications direct to the applicant.

3. Applicants **with** a residence or their principal place of business in an EPC contracting state are not obliged to appoint, for the European phase before the EPO as designated or elected Office, a professional representative authorised to act before the EPO.
However, in view of the complexity of the procedure it is recommended that they do so.
4. Applicants and professional representatives are also strongly advised to initiate the European phase using EPO Form 1200 (available free of charge from the EPO). This however is not compulsory.



5. To enter the European phase before the EPO, the following acts must be performed.
(N.B.: Failure validly to do so will entail loss of rights or other adverse legal consequences.)

- 5.1 If the EPO is acting as **designated** or **elected** Office (Arts. 22(1)(3) and 39(1) PCT respectively), applicants must, within 31 months from the date of filing or (where applicable) the earliest priority date:

- a) Supply a translation of the international application into an EPO official language, if the International Bureau did not publish the application in such a language (Art. 22(1) PCT and R. 107(1)(a) EPC).
If the translation is not filed in time, the international application is deemed withdrawn before the EPO (R. 108(1) EPC).
This loss of rights is deemed not to have occurred if the translation is then filed within a two-month grace period as from notification of an EPO communication, provided a surcharge is paid at the same time (R. 108(3) EPC).
- b) Pay the national basic fee (EUR 170,00) and, where a supplementary European search report has to be drawn up, the search fee (EUR 720,00 ; R. 107(1)(c) and (e) EPC).
- c) If the time limit under Article 79(2) EPC expires before the 31-month time limit, pay the designation fee (EUR 80,00) for each contracting state designated (R. 107(1)(d) EPC).
- d) If the time limit under Article 94(2) EPC expires before the 31-month time limit, file the written request for examination and pay the examination fee (EUR 1490,00 ; R. 107(1)(f) EPC).
- e) Pay the third-year renewal fee (EUR 400,00) if it falls due before expiry of the 31-month time limit (R. 107(1)(g) EPC).

If the fees under (b) to (d) above are not paid in time, or the written request for examination is not filed in time, the international application is deemed withdrawn before the EPO, or the contracting-state designation(s) in question is (are) deemed withdrawn (R. 108(1) and (2) EPC). However, the fees may still be validly paid within a two-month grace period as from notification of an EPO communication, provided the necessary surcharges are paid at the same time (R. 108(3) EPC). For the renewal fee under (e) above, the grace period is six months from the fee's due date (Art. 86(2) EPC).

For an overview of search and examination fees, see OJ EPO 11/2005, 577 and 03/2006.

- 5.2 If the application documents on which the European grant procedure is to be based comprise more than ten claims, a claims fee is payable within the 31-month time limit under Rule 107(1) EPC for the eleventh and each subsequent claim (R. 110(1) EPC). The fee can however still be paid within a one-month grace period as from notification of an EPO communication pointing out the failure to pay (R. 110(2) EPC).

6. If the applicant had a representative during the application's international phase, the present notes will be sent to the representative, asking him to inform the applicant accordingly.

All subsequent communications will be sent to the applicant, or - if the EPO is informed of his appointment in time - to the applicant's European representative.



Date

Sheet 3

Application No. 05730024.6

7. For more details about time limits and procedural acts before the EPO as designated and elected Office, see the EPO brochure

How to get a European patent
Guide for applicants - Part 2
PCT procedure before the EPO - "Euro-PCT"

This brochure, the list of professional representatives before the EPO, Form 1200 and details of the latest fees are now all available on the Internet under

<http://www.european-patent-office.org>

Receiving section



From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Article 31(7) and Rule 61.2)

To:

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in its capacity as elected Office

Date of mailing (<i>day/month/year</i>) 15 December 2005 (15.12.2005)	
International application No. PCT/US2005/008297	Applicant's or agent's file reference 010-0011A
International filing date (<i>day/month/year</i>) 11 March 2005 (11.03.2005)	Priority date (<i>day/month/year</i>) 13 March 2004 (13.03.2004)
Applicant CLUSTER RESOURCES, INC. et al	

1. The designated Office is hereby notified of its election made in the demand filed with the International Preliminary Examining Authority on:

11 October 2005 (11.10.2005)

2. The election ☒ was
☐ was not

made before the expiration of 19 months from the priority date (PCT Article 39(1)(a)).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.+41 22 740 14 35	Authorized officer Philippe Becamel Facsimile No.+41 22 338 70 90
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Document made available under the Patent Cooperation Treaty (PCT)

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International filing date: 11 March 2005 (11.03.2005)

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World Intellectual Property Organization (WIPO) - Geneva, Switzerland
Organisation Mondiale de la Propriété Intellectuelle (OMPI) - Genève, Suisse